

Heating of Io's Atmosphere from Surface not Spot Infrared Emissions

M A Moreno and D Winterhalter (Jet Propulsion laboratory, California institute of Technology, 4800 Oak Grove Drive, MS 169-506, Pasadena, CA 91 109-8009; 818-354-3238)
J Baumgardner (Los Alamos National Laboratory, Los Alamos, NM 87545)

We have carried out numerical gas dynamic simulations of a volcanic atmosphere on Io in order to explain recent millimeter-wave observations of SO₂. These observations show that Io's atmosphere has a temperature of 500-600 K at 40 km of altitude while the surface has a maximum temperature of 130 K due to solar irradiation. In our simulations we include a relatively small surface hot spot at 650 K inside the plume and find that infrared radiation from such a hot spot is capable of warming up the atmosphere to high temperatures. Our model includes thermal conductivity and radiative transfer in the atmosphere. The inclusion of hot spots is based on our assessment that they are important in the energetics of the atmosphere, and on recent infrared measurements of ten hot spots which show that they vary in radius and in temperature from 5 km to 625 km and from 145 K to 700 K respectively. We include an atmospheric emissivity of 10⁻⁵ and a source rate of 10⁶ kg/sec based on Voyager observations, and an exit temperature of 100 K based on models of volcanism for Io. The surface behaves as a source of mass and energy through sublimation and as a sink of mass, energy and momentum through condensation. In the model, the hot spot does not have any volatiles left to sublimate. The simulations produce an atmosphere with a temperature, pressure, and density structure consistent with multiple observations. We focus our analysis of the observed hot spots, and on the effect of these on the thermal structure of the atmosphere. We also evaluate the effects of volcanic aerosols on the thermal structure of the atmosphere.

1. 1993 Fall Meeting
2. 011633400
3. (a) M A Moreno
Jet Propulsion Laboratory
4800 Oak Grove Drive
MS 169-506
Pasadena, CA 91109-8099

(b) tel:310-447-5495

(c) fax: 818-354-8895
4. P
5. (a) P
(b) 5445
6. Oral
7. 0%
8. \$50 check enclosed
9. C
10. None
11. No